

THEREFORE WHAT IS CLAIMED IS:

1. A polymer-based ammunition, comprising:
a composite material including
a polymer matrix including at least one thermoplastic elastomeric polymer (TPE) component, and at least one soft elastomeric polymer component;
particles of a sufficiently high specific gravity material that are dispersed in the polymer matrix and present in an amount such that the composite material has a specific gravity of in a range from about 2 to 3 grams per cubic centimeter; and
the composite material having a shape of a pre-selected projectile.
2. The polymer-based ammunition according to claim 1 wherein the thermoplastic elastomeric polymer (TPE) component comprises a block copolymer having at least one elastomeric block.
3. The polymer-based ammunition according to claim 2 wherein the thermoplastic elastomeric polymer (TPE) component is selected from the group consisting of polystyrene-polyisobutylene block copolymers, polystyrene-polybutadiene block copolymers, polystyrene-polyisoprene block copolymers, polystyrene-poly(ethylene-butylene) block copolymers, polystyrene-poly(ethylene-propylene) block copolymers, thermoplastic polyolefins (TPOs), and dynamically vulcanized TPVs.
4. The polymer-based ammunition according to claim 1, 2 or 3 wherein the thermoplastic elastomeric polymer (TPE) component has a structure selected from the group consisting of linear, star, arborescent, comb, brush, centipede, hyperbranched, and dendritic.
5. The polymer-based ammunition according to claim 1, 2, 3 or 4 wherein the elastomeric polymer component is selected from the group consisting of

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polyisobutylene, polyisobutylene-isoprene copolymers, polyisobutylene-styrene copolymers, polyisobutylene- alkyl styrene copolymers, halogenated polyisobutylene- alkyl styrene terpolymers, polybutadiene, polyisoprene, polyethylene-propylene copolymers, polyethylene-propylene diene terpolymers.

6. The polymer-based ammunition according to claim 1, 2, 3 or 4 wherein the elastomeric polymer component is polyisobutylene, and wherein the thermoplastic elastomeric polymer (TPE) component is polystyrene-polyisobutylene-polystyrene (SIBS).

7. The polymer-based ammunition according to claim 1, 2, 3 or 4 wherein the elastomeric polymer component is a polyisobutylene-isoprene copolymer, and wherein the thermoplastic elastomeric polymer (TPE) component is polystyrene-polyisobutylene-polystyrene (SIBS).

8. The polymer-based ammunition according to claim 1, 2, 3, 4, 5, 6 or 7 wherein the elastomeric polymer component is present in an amount from about 10% to about 90% by weight of the polymer matrix, and wherein the thermoplastic elastomeric polymer component is present in an amount from about 90 to about 10% by weight of the polymer matrix.

9. The polymer-based ammunition according to claim 1, 2, 3, 4, 5, 6 or 7 wherein the elastomeric polymer component is present in an amount from about 40% to about 60% by weight of the polymer matrix, and wherein the thermoplastic elastomeric polymer component is present in an amount from about 60 to about 40% by weight of the polymer matrix.

10. The polymer-based ammunition according to claim 5 wherein the elastomeric polymer component has a structure selected from the group consisting of linear, star, arborescent, comb, brush, centipede, hyperbranched and dendritic.

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11. The polymer-based ammunition according to claim 1, 2, 3, 4 or 5 wherein the specific gravity of the composite material is at least about 2.44 grams per cubic centimeter.
12. The polymer-based ammunition according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the high specific gravity material is present in the composite material in an amount of from about 50 to about 90% by volume of the total composite.
13. The polymer-based ammunition according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the high specific gravity material is present in the composite material in an amount of from about 60 to about 80% by volume of the total composite.
14. The polymer-based ammunition according to claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 or 11 wherein the high specific gravity material is present in the composite material in an amount of from about 10 to about 90% by volume of the total composite.
15. The polymer-based ammunition according to any one of claims 1 to 4 wherein the composite material has a cylindrical or spherical shape.
16. The polymer-based ammunition according to any one of claims 1 to 15 having a hardness value, as measured according to the Shore A scale, in a range of from about 15 to about 80.
17. The polymer-based ammunition according to any one of claims 1 to 15 having a hardness value, as measured according to the Shore A scale, in a range of from about 30 to about 55.
18. The polymer-based ammunition according to any one of claims 1 to 17 wherein the particles of a high specific gravity material are selected from the group consisting of iron powder, tungsten, copper, bismuth, and iron oxide.

19. The polymer-based ammunition according to any one of claims 1 to 17 wherein the particles of a high specific gravity material are iron powder particles.
20. The polymer-based ammunition according to claim 19 wherein the iron powder particles have sizes in a range from about 71.4% of -100 to +325 U.S. Mesh and 23.2% of -325 U.S. Mesh, specific gravity, 7.8 gcm^{-3} .
21. The polymer-based ammunition according to any one of claims 1 to 20 produced by molding the composite material into any one of a cylindrical or spherical shape.
22. The polymer-based ammunition according to claim 21 wherein the step of molding is one of injection molding and compression molding.
23. The polymer-based ammunition according to any one of claims 1 to 22 wherein the composite material has a dynamic mechanical compression creep below a threshold creep so that the polymer-based ammunition maintains its shape.
24. The polymer-based ammunition according to any one of claim 23 wherein said threshold dynamic mechanical compression creep is about 20%.
25. The polymer-based ammunition according to claim 23 wherein dimensions of the composite material do not change more than 10% for at least a year.
26. The polymer-based ammunition according to any one of claims 1 to 23 wherein the composite material has a dynamic mechanical compression creep between 4 and 20% creep.
27. A composite material, comprising:
a polymer matrix including at least one thermoplastic elastomeric polymer (TPE) component, and at least one soft elastomeric polymer

component, the thermoplastic elastomeric polymer (TPE) component including a block copolymer having at least one elastomeric block, the material characterized in that it exhibits a dynamic mechanical compression creep below a threshold creep so that the composite material maintains its shape.

28. The polymer-based ammunition according to claim 27 wherein the thermoplastic elastomeric polymer (TPE) component is selected from the group consisting of polystyrene-polyisobutylene block copolymers, polystyrene-polybutadiene block copolymers, polystyrene-polyisoprene block copolymers, polystyrene-poly(ethylene-butylene block copolymers, polystyrene-poly(ethylene-propylene) block copolymers, thermoplastic polyolefins (TPOs), and dynamically vulcanized TPVs.

29. The composite material according to claim 27 or 28 wherein the elastomeric polymer component is selected from the group consisting of polyisobutylene, polyisobutylene-isoprene copolymers, polyisobutylene-styrene copolymers, polyisobutylene- alkyl styrene copolymers, halogenated polyisobutylene- alkyl styrene terpolymers, polybutadiene, polyisoprene, polyethylene-propylene copolymers, polyethylene-propylene diene terpolymers.

30. The composite material according to claim 27, 28 or 29 wherein the thermoplastic elastomeric polymer (TPE) component and the elastomeric polymer component have a structure selected from the group consisting of linear, star, arborescent, comb, brush, centipede, hyperbranched, and dendritic.

31. The composite material according to claim 27, 28, 29 or 30 including particles of a high specific gravity material that are dispersed in the polymer matrix and present in an amount such that the composite material has a specific gravity of in a range from about 2 to 3 grams per cubic centimeter.

32. The composite material according to claim 31 wherein the particles of a high specific gravity material are selected from the group consisting of iron powder, tungsten, copper, bismuth, and iron oxide.
33. The composite material according to claim 31 wherein the particles of a high specific gravity material are iron powder particles.
34. The composite material according to claim 26, 27, 28, 29, 30, 31, 32 or 33 wherein the elastomeric polymer component is one of polyisobutylene and polyisobutylene-isoprene copolymer.
35. The polymer-based ammunition according to any one of claims 26 to 33 wherein said threshold dynamic mechanical compression creep is about 20%.
36. The polymer-based ammunition according to any one of claims 26 to 35 wherein the composite material has a dynamic mechanical compression creep between 4% and 20% creep.
37. The polymer-based ammunition according to any one of claims 27 to 34 wherein dimensions of the composite material do not change more than 10% for at least a year.